AL-TR-1991-0032

ARMSTRONG LABORATORY

CONTRACTOR-SUPPORTED AIRCREW TRAINING SYSTEMS: ISSUES AND LESSONS LEARNED

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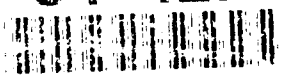
August 1991

Final Report for Period January 1989 to February 1991

Approved for public release; distribution is unlimited.



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This report has been reviewed and is approved for publication.

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 1991	Final - January 1989 to February 1991

4. TITLE AND SUBTITLE
Contractor-Supported Aircrew Training Systems:
Issues and Lessons Learned

5. FUNDING NUMBERS
C – F33615-90-C-0005
PE – 62205F
PR – 1123
TA – 03
WU – 85

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)
Armstrong Laboratory
Human Resources Directorate
Aircrew Training Research Division
Williams Air Force Base, AZ 85240-6457

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AL-TR-1991-0032

11. SUPPLEMENTARY NOTES
Armstrong Laboratory Technical Monitor: Ms. Pat Spears, (602) 988-6561, Ext. 188.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The current trend within the Air Force is to design aircrew training programs as *total integrated systems* rather than as collections of courses or blocks of instruction. This trend has been coupled with a concurrent shift to contracting-out the design, delivery, and support of aircrew training. These changes have introduced a new set of technical and management issues which impact the design, development, evaluation, and operation of aircrew training programs. AL/HRA is conducting research and development to address several of these issues in order to provide principles, procedures, and user-oriented guidelines to support Air Force acquisition and operational training agencies. In this review, data were collected from several Air Force aircrew training system (ATS) programs to identify the major issues and lessons learned during the design, development, evaluation, and operation of these systems. In addition, data were also obtained from selected Navy and allied forces aircrew training systems to serve as a cross-check on the generality of the Air Force findings. The major findings of the ATS review are summarized, and key issues and lessons learned are identified and discussed.

14. SUBJECT TERMS
aircrew training
aircrew training systems
contract instruction
contract training
contractor-supported training
total training systems

15. NUMBER OF PAGES
48

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

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PREFACE

This report summarizes the progress and findings to date of work conducted to develop a training systems design/"lessons learned" database. The work described is part of a larger program concerned with the development of principles and guidelines for the design, development, evaluation, and operation of total aircrew training systems, which is being accomplished by the University of Dayton Research Institute (UDRI) under Contract F33615-90-C-0005 with Aircrew Training Research Division of the Armstrong Laboratory's Human Resources Directorate (AL/HRA). The contract monitor was Capt Claire Fitzpatrick. The work was conducted under Work Unit 1123-03-85, Flying Training Research Support.

The authors wish to express their appreciation to all of the Government civilian and military personnel who gave freely of their time and provided the information which made this review possible. Special thanks are also due to Ms. Marge Keslin of UDRI, who provided invaluable support throughout the preparation and publication of this report.

CONTRACTOR-SUPPORTED AIRCREW TRAINING SYSTEMS: ISSUES AND LESSONS LEARNED

SUMMARY

The U.S. Air Force's experience with respect to the design of total aircrew training systems (ATS) is quite limited. To date, most of the major Air Force ATS programs have not been acquired and/or completely implemented. Thus, there is a pressing need to develop and disseminate empirically validated principles, criteria, and/or "lessons learned" to training system acquisition offices and operational training organizations to ensure a cost-effective approach in the design, development, and use of total aircrew training systems. In response to this need, AL/HRA initiated a program to perform the analyses and research required to develop a total training system design database to support the preparation of user-oriented guidelines and to serve as a research and development resource.

A comprehensive review was made of several Air Force ATS programs (e.g., KC-10, C-5, and C-130). The primary purpose of this review was to identify the major issues and lessons learned during the design, development, evaluation, and operation of these systems. In addition, data were also obtained from selected Navy and allied forces aircrew training systems tc serve as a cross-check on the generality of the Air Force findings. The major findings of the ATS review are summarized, and the key issues and lessons learned are identified and discussed.

INTRODUCTION

This report summarizes the progress and findings to date of work conducted to develop an aircrew training system design/ "lessons learned" database. The work described is part of a larger program concerned with the development of principles and guidelines for the design, development, evaluation, and operation of total aircrew training systems.

Background

The current trend within the U.S. Air Force is to design aircrew training programs as *total integrated systems* rather than as collections of courses or blocks of instruction. This trend has been coupled with a concurrent shift to contracting out the design, delivery, and support of aircrew training. These changes have introduced a new set of technical and management issues which impact the design, development, evaluation, and operation of aircrew training programs. The Aircrew Training Research Division (AL/HRA) is currently conducting research and development (R&D) to address several of these issues in order to provide principles, procedures, and user-oriented guidelines to support Air Force acquisition and operational training agencies.

Many current aircrew training programs have been characterized as being largely lock-step, labor-intensive, and inefficient. Frequently, these programs are comprised of phases and blocks of instruction which have been independently designed and developed in relative isolation from the "system" as a whole. As a consequence, there are frequent gaps or unnecessary redundancies across blocks of training. It is often the case that the aircraft itself, which is usually the most costly resource, is used to compensate for instructional deficiencies that could have been corrected in much less expensive ways. In addition, because of the lack of integration across components and subsystems of the total system, current programs are often relatively inflexible and/or inefficient in adapting to changes such as those imposed by modifications in operational requirements, variations in student flow, and the introduction of new training technologies. For instance, often when a new technology (e.g., a high-capability flight simulator) is introduced into an existing program, it is treated as an add-on cost for local facilities and operations and maintenance (O&M) rather than as an opportunity to improve the overall cost-effectiveness of the total training system.

As a result of such deficiencies, there is a growing recognition within the Air Force, as well as the other military services, of the need to design, develop, evaluate, and operate aircrew training programs as total systems rather than as relatively disjointed sets of components and/or phases of training. Currently, the Air Force is involved in the development/operation of a number of aircrew training programs from a total training system point of view. Virtually all of these programs are being developed and operated with some measure of contractor support. For example, one of the major new initiatives is the C-130 Aircrew Training System (ATS), which is currently being developed for the Military Airlift Command (MAC) at Little Rock AFB, Arkansas, under a contract with the CAE-Link Corporation. In addition to the C-130 ATS, each of the Air Force using commands is also planning, developing, and/or operating a number of other contractor-supported

aircrew training programs such as the E-3A, F-15, and F-16 (Tactical Air Command); KC-10 and B-52/KC-135 (Strategic Air Command); C-5, C-141, C-17, and Special Operations Forces (SOF) (MAC); and the TTTS (Tanker-Transport Training System) of the Air Training Command.

Most of the Air Force's major ATS programs are only in the early stages of the system life cycle. As a consequence, there is relatively little empirical and/or experiential information to provide guidance for the design, development, evaluation, and operation of new or proposed systems. In fact, in most of the systems reviewed to date the program managers began at ground zero and had to "learn by doing," except for occasional consultation with personnel in other programs who were somewhat farther along than they were. To promote communication among the various programs and agencies involved in the development and operation of total aircrew training systems, AL/HRA and Training System SPO of the Aeronautical Systems Division (ASD/YW) jointly established the Training System Training Effectiveness Working Group (TEWG). This TEWG has proved to be a very useful forum for facilitating inter-program communication and information exchange. However, to be solely dependent on occasional personal contacts and/or undocumented corporate memory for guidance is a less-than-optimum procedure for use in the development of major training programs. Thus, there is a critical need to systematically collect and document experientially based "lessons learned" and disseminate them to training system acquisition offices and operational training organizations to ensure a more cost-effective approach in the design, development, and evaluation of both ongoing and future aircrew training systems. Because of the number of aircrew training systems at various stages of development at the present time, a window of opportunity is available for collecting lessons learned during various phases of the training system life cycle.

Objectives

The general objective of this program is an aircrew training system design/lessons learned database for use as an R&D resource and as a source of information for the development of user-oriented guidelines for the cost-effective design, development, and evaluation of total integrated aircrew training systems. The primary objectives of this specific effort were (a) to collect lessons learned by Air Force and contractor personnel in selected Air Force contractor-supported aircrew training programs, and (b) to identify and document key issues/problem areas which could serve as a structure for follow-on data collection, as well as provide a focus for the development of a high-payoff R&D plan.

An ancillary objective was to solicit issues/lessons learned in contractor-supported aircrew instruction from the various allied military agencies represented by the members of the Training Technology Panel (UTP-2) of The Technology Cooperation Program

(TTCP). (The TTCP membership includes representatives from the military services of the United Kingdom, Canada, Australia, New Zealand, and the United States.) The TTCP review was requested by Dr. Wayne Waag (AL/HRA), the Chairman of UTP-2, following a strong show of interest by members of the panel regarding a point paper on "Issues in Contracted Instruction" prepared by Dr. Robert Nullmeyer of AL/HRA (see Appendix A).

Purpose of the Present Report

The primary purpose of the present report is to summarize the activities and findings of this effort to date and to describe the goals and objectives for the future. The report is divided into six major sections. Introduction provides the rationale and describes the objectives of this effort. Method summarizes the general approach for the entire multi-year program, as well as the specific approach used in this effort. It also lists the training systems reviewed during the period covered by this report and identifies some of the major information sources. Findings summarize the major lessons learned and issues identified. Discussion considers some of the implications of the findings to date and discusses the plans for follow-on actions. Bibliography lists information sources for this research. Finally, Appendix A and Appendix B contain documentation that augments the information contained in the main body of the report.

METHOD

General Approach

The approach for the overall program consists of three overlapping phases.

Phase 1. The first phase is a continuing cross-sectional and longitudinal data collection effort. It includes a series of visits to sites where total aircrew training systems are being planned, developed, and/or operated. Major training system issues and lessons learned are solicited from both contractor and military personnel involved in all phases of the training system life cycle. Much of the information being developed is based on personal interviews as well as the authors' personal participation in selected programs. During the initial contacts, specific lessons learned and issues are identified through somewhat open-ended discussions. Where feasible, an effort is made to obtain additional information concerning what problems are/were being experienced and what approaches, techniques, and procedures were developed to resolve them that might be of value to others. Several potentially profitable areas and issues have been identified; these are being monitored through periodic visits, telephone communications, and structured questionnaires.

Phase 2. During the second phase of this program, several generic ATS issues/functions are being selected for further in-depth review and analysis. Among the specific areas already identified for more detailed study are (a) test and evaluation, (b) aircrew performance measurement methodology, (c) techniques for management of the courseware development process, (d) training management system design (including scheduling and resource allocation), and (e) the use of flight simulators for combat-oriented aircrew training.

Phase 3. During Phase 3, the information concerning the major issues and lessons learned will be documented in a series of user-oriented reports and guidelines for dissemination to procurement personnel, training system designers, training system acquisition agencies, training managers, and R&D personnel. The guidelines should effect a significant improvement in the effectiveness and efficiency of system design, development, evaluation, and utilization processes. In addition, the lessons learned database should be a prime source of guidance for identifying, organizing, and prioritizing significant training system R&D issues.

Specific Approach

The primary emphasis during the initial phase of the program was to establish contact with a number of major Air Force aircrew training programs that could serve as continuing sources of information throughout this effort. In addition, an attempt was made to identify other aircrew training programs in the Air Force, as well as other military agencies that might merit more thorough review and analysis in the future. Visits were made to a number of contractor and military facilities to interview key management and technical personnel in order to gain a better understanding of the program(s) in which these personnel were involved and to solicit their opinions concerning important issues and lessons learned to date. In most cases, follow-on visits and/or telephone interviews were conducted to clarify particular points and to obtain additional information. In addition to the personal interviews, considerable time was spent reviewing program documentation and other relevant published information. Another source of data for the authors was derived from their own participation in various phases of the C-130 MATS (Model Aircrew Training System), C-130 ATS, B-52/KC-135 Combat Crew Training School (CCTS) Modernization, and the SOF ATS programs. The primary information sources and systems covered during this first phase are shown in Table 1, and a listing of some of the major U.S. Air Force and Navy contractor-supported systems appears in Table 2.

Most of the initial interviews with key program personnel were relatively unstructured and open-ended. However, later interviews tended to become more focused as a number of major issues which appeared to be common across several systems began to emerge. These issues were also used to structure a questionnaire that was

Table 1. Major U.S. Sources for Issues/"Lessons Learned" Data

Organization	System(s)
CAE-Link	C-130, C-5
CAE-Link	C-130
MAC	C-5
MDTS	KC-10
MDCBTS	C-17, TTTS
SAC	KC-10, B-52/KC-135
AL/HRA	B-52/KC-135
USAC	E-4
MAC	C-130
AL/HRA	F-5
MDCBTS	T-45
MAC	C-5
TAC	E-3A, F-15/F-16
MAC	C-130
Arizona ANG	F-16/A-7
MDCBTS	T-45
USAC	C-5
NTSC	E-6A
SAC	KC-10
TAC	E-3A
MAC	C-5
Navy	F-18

Table 2. Some Major U.S. Contractor-Supported Aircrew Training Systems

Sponsor	Aircraft	Prime contractor
USAF (MAC)	C-130	CAE-Link
USAF (MAC)	C-5	Flight Safety International
USAF (MAC)	C-17	McDonnell Douglas
USAF (SAC)	KC-10	McDonnell Douglas
USAF (TAC)	E-3	Boeing Simulation
USN	E-6A	McDonnell Douglas
USN	T-47	Cessna
USN/USMC	EA-6B	Simuflite
USN/USMC	T-45	McDonnell Douglas

used to survey UTP-2 members regarding contractor-supported training. The TTCP questionnaire and supporting materials are contained in Appendix A.

FINDINGS

The primary data collected during this phase were lessons learned by key personnel in the programs selected for review. Because the initial sample of interviewees consisted mainly of contractor and military program and/or site managers, most of the data relate to procurement and management issues. In addition, most of the major systems reviewed were still under development or in the early stages of implementation at the time the data were obtained. Thus, most of the systems did not have sufficient operational run time to assess or validate the longer-term impacts of many of the early technical and management decisions taken. In addition, although there is a fair amount of consistency in the lessons learned identified by the personnel interviewed to date, there are also a few apparent inconsistencies. In general, these result, at least in part, from obvious differences between Government and contractor perspectives; differences in the kinds of systems and the levels of contractor or Government involvement; and differences in the operational, training, and management philosophies among the various military agencies.

Some of the representative lessons learned data obtained from personnel involved in the C-130, C-5, and KC-10 ATS programs are summarized in this section for illustrative purposes. Where appropriate, the data are also listed as being derived from a contractor or Air Force source. The C-130, C-5, and KC-10, C-141, C-17, and the SOF ATS will be among the primary sources continually monitored for follow-on data collection. A separate subsection documents lessons learned by AL/HRA in working with more than one program.

An index of the issues/lessons learned for the core systems is contained in Appendix C. Each lesson learned is labeled with a provisional database field for classification and filing purposes. (The current field structure may be modified in the future as additional data become available.)

C-130 ATS

C-130 ATS Description

The C-130 ATS is an integrated, contractor-supported training system being developed to provide ground-based training for C-130 aircrews. The C-130 ATS contract includes 28 courses for the Department of Defense (DoD) formal school at Little Rock AFB, and all C-130E- and H-model continuation training. The system includes the optimized use of existing training assets, including 10 C-130 Weapon System Trainers (WSTs); two cockpit procedures trainers

(CPTs); and several part-task trainers (PTTs), which are to be furnished "as is" to the contractor by the Government. It also includes all maintenance and logistics support for the WSTs and other PTTs within the program. It includes total system management of all ground-based training using computerized management tools, all scheduling, and all training scenarios for the flying environment. It also includes a proficiency-based training continuum which begins with entry intc the formal school and ends with either transfer out of the weapon system or retirement.

Under the C-130 ATS concept, the contractor is responsible for the entire Instructional Systems Development (ISD) process from beginning to end, including formative, summative, and operational evaluations. The contractor is responsible for the development and production of all courseware, all ground instruction, all hardware modifications, and any new software development. The contractor is also responsible for the total operation, maintenance, and support of the ground-based training system; all student management; administration; configuration management; and quality assurance.

C-130 ATS Issues/Lessons Learned

Air Force Issues/Lessons Learned

Contractor Education: Contractors must go through a relatively long familiarization/educational process before they know enough about a given system to conduct an effective and efficient ISD process.

Computer-Based Training (CBT) Costing: There is a general tendency to greatly underestimate the time and cost required to develop good CBT lessons. (At the time of this review, one of the contractor's CBT development personnel noted that it was taking about 400 hours to develop a 1-hour CBT lesson.)

Student Evaluation/Guarantee: There should be a contractual requirement to ensure that all check ride evaluations be tied back to training objectives. In fact, documentation of the correlation between check ride performance and contractor-identified objectives should be made a contract deliverable. It is acknowledged, however, that it is not always easy to identify a direct link between all relevant enabling objectives and the particular sample of aircrew behaviors evaluated during the check ride, for a single check ride is simply the top of the student evaluation pyramid. Within a single course, the contractor is responsible for teaching hundreds of objectives, many of which are not tested in the aircraft (e.g., ditching, serious malfunctions). Therefore, it is necessary that the means and the results of all tests/checks be made visible to the Government sponsor.

Course Evaluation Data: The contract should stipulate that the Government be provided with every writeup generated by individual

tryouts during the course development process. This should help ensure that when individual tryouts have been completed, all major courseware technical issues have been resolved.

On-Site Development: It is highly advantageous to have the contractor develop the training program on the site where it will be implemented. This facilitates day-to-day communication with the user, which expedites information gathering and tends to promote better design decisions. Perhaps this requirement may be relaxed somewhat for a "brand new system like the C-17, where there is no available operational expertise."

Management: There is a need to have dedicated Air Force operational specialists on site during the development, test, and evaluation of an ATS. These personnel should serve as the contractor's official focal points for subject-matter expertise in each of the crew positions represented in the system. In addition, they can support the acquisition agency by providing day-to-day oversight of contractor progress and performance. In the C-130 ATS, HQ MAC established MACOS OL Q (Military Airlift Combat Operational Support Operating Location Q) at Little Rock AFB to provide these functions. MACOS OL Q consisted of 11 persons, including two civilian quality assurance specialists. The military personnel were all rated specialists and on controlled tours until PMRT (Program Management Responsibility Transfer).

Course Content: Fearing potential legal problems, the contractor was hesitant to teach useful "techniques" not identified in the official technical orders. To ensure that appropriate techniques would not be excluded from the new program, a policy was established to enable the contractor to submit proposed technique information to the Air Force for approval prior to inclusion in the program.

Configuration Control/System Baseline: Training systems are much more dynamic than most operational hardware/software systems. This creates particular problems in the courseware and the training management system areas where any given change tends to ripple to other elements of the system. For example, a change in the content of a specific lesson imposed by changes in operational equipment, procedures, instructional approach, etc. usually will affect other elements of the system such as test items, student orientation manuals, and course summary documents. In the C-130 ATS, we have tailored the traditional configuration management procedures (AFR 57-4, Modification, Approval, and Management) to ensure that we identify the impact of any proposed change on other parts of the system before the change is approved. When a change is implemented, the underlying system baseline documentation is also updated so that the Air Force is always in a position to permit recompetition and reprocurement when necessary.

Contract/Proposal: One respondent stated, "Be sure to put the contractor's proposal on contract!" (Note: This lesson learned was identified as one of the most important provided by this respondent. It was a reaction to the tendency for some contractor bidders to write impressive proposals which are ignored after contract award because the proposals were not contractually binding.)

Front-End Analysis (FEA) Cost and Data: The C-130 ATS program evolved from a pre-contractual front-end analysis and preliminary design study. This detailed FEA was a major contributor to the success of the program. However, a major lesson learned was that the job/task analysis data should be delivered on magnetic media in a format that is compatible with the user's computer capability. Another lesson learned was that the task analysis consumed the bulk of the contract resources for the FEA. The FEA is a very labor-intensive enterprise, but it is key to the development of a relevant training program.

Statement of Work (SOW): The FEA served as the baseline for the SOW. The SOW should permit the contractor flexibility in his approach, but should identify the constraints within which he must operate. It should include the baseline analysis and training requirements as part of the package. It should also detail site activation requirements and the requirement to develop and maintain a recompetition package, as well as concurrency management of the hardware and software within the system.

Instructions to Offerers (ITOs): It is very important that the instructions to offerers conform to the statement of work and system specification in order to facilitate tracking during the proposal evaluation process.

Source Selection: It is important to ensure that highly competent instructional technologists and training experts be included as members of, or consultants to, the source selection team because of the difficulty of identifying definitive criteria for an acceptable training system design.

In the hardware/software areas, the specification of "best commercial practice" provides contractors with greater flexibility as to how they will satisfy a given set of requirements, but it also demands a greater level of expertise on the part of the Air Force reviewers to evaluate the feasibility and potential risk of a proposed technical approach.

Program Cost Evaluation: Contractor cost evaluations should be based solely upon the proposed ground training program. The SOW should require an optimized flying hour program based on the contractor's proposed ground training program and evaluated solely

on technical content. This is a feasible approach as the cost of flying hours is a command operations and maintenance (O&M) requirement and the final decision on use of these hours falls within the using command's authority, not within the jurisdiction of the contractor or procuring agency. (Authors' note: This recommendation may not be applicable for ATSs like the E-3A and E-6A where the contractor is responsible for the O&M of training aircraft.)

Courseware Costing: It is beneficial to include a requirement (and the funds) for timely courseware updates at no additional charge to the contract. This will allow changes to technical orders (T.O.s), flight manuals, etc. (which affect the training program) to be accommodated without having to go through another costing loop and/or contract amendment for every change.

Student Costing: The contract should include a provision and a source of funds to cover the additional costs that may be incurred because of unprogrammed surges in student input or changes in instructional resources. (Authors' note: These contingencies have been covered in some training systems by factoring-in the cost of an estimated change factor and/or providing a "management reserve" contingency fund to cover unanticipated changes.)

Task/Objective Data: The contract should be absolutely clear about the level of detail to which tasks and objective data are to be developed. These details will result in satisfying and tracking the training requirements of the guaranteed student.

Production Tracking: A system is needed to track the status of courseware (as well as hardware, software, etc.) during development. For any large program, it is necessary to automate the process in order to adequately monitor the hundreds of separate items under development. In the C-130 ATS program, a multi-step courseware development process was implemented. Each lesson development plan had a schedule for meeting the requirements of each step. The information was fed into a computer for tracking purposes, and the lesson was flagged for potential management attention if it was ahead or behind its proposed schedule by 3 days.

System Integration: A training system must be developed as a total integrated system. Unfortunately, because of the lack of experience with large-scale training systems (as opposed to courses), it is too easy to fractionate the development effort among interrelated specialists and functions in the drive to meet scheduled milestones. This can lead to problems at critical system interfaces and produce inefficient and/or ineffective system performance.

Guaranteed System: It is necessary to exercise program management disciplines such as quality assurance, quality control, and test and evaluation to ensure that the overall training system is meeting all of its specified goals and functional requirements throughout the system life cycle. (Authors' note: During the development phase of the C-130 ATS, the on-site HQ MAC unit, MACOS OL Q, performed many of the required functions for the Air Force. Currently, the 34 TATG (Tactical Airlift Training Group) has established a special unit at Little Rock AFB to continuously review and monitor system performance for the duration of the system life cycle.)

Contractor Issues/Lessons Learned

Organization/Management: The Test and Evaluation function should report to the Program Manager.

Organization/Management/Development: The Test and Evaluation process supports system integration.

Test and Evaluation: As much development as possible should be completed during formative evaluation. Small-group tryouts should employ finished courseware, hardware/software, and media and should run the entire course from beginning to end.

Organization/Management: The Air Force and the contractor should function together as a team and not as adversaries. For example, the Air Force and the contractor should work together closely to ensure that proposed changes in regulations, T.O.s, etc. are coordinated as early as possible. (In the C-130 ATS, this was accomplished by MACOS OL Q prior to PMRT and by the dedicated on-site group in the 34 TATG thereafter.)

Instructional Systems Development: Individual tryouts should be at the instructional unit (block) level. (In the C-130 ATS, the "unit" is defined as a collection of lessons on a given topic; e.g., hydraulics.) When tryouts involve the whole unit, one should check not only the individual lessons but how well they fit together as an instructional unit. In courses with large numbers of units and even larger numbers of lessons, this approach can lead to considerable economies in the use of available student test subjects and in the number of reviews. In addition, in existing courses that are being redesigned, it is often possible to substitute the new unit for an old (with the same objectives), with minimal disruption of student flow.

Student Evaluation/Guarantee: Student guarantee requires that all objectives be trained and tested prior to the flight check. The flight check covers only a sample of the training objectives; it should, therefore, be viewed as one part of the "guarantee." The

Air Force should exercise oversight of this function and should periodically spot-check tc ensure that all objectives are being trained and tested in the contracted part of the system.

Test and Evaluation Staffing: It is important to use trained and experienced personnel for test and evaluation. Air Force flight examiner/stan-eval experience does not qualify personnel to perform the system test and evaluation functions.

Marketing/User Participation: The Air Force should ensure that the field users of the ATS know and understand that the system is coming and why. In one case, for example, field personnel said that they were not going to use the new 5-point flight check rating scale because it was not specified in the regulations.

Personnel Management: Air Force military personnel responsible for the management and support of the ATS program should be on controlled tours for the duration of the development program, to minimize program turbulence and disruption.

Test and Evaluation: Test and evaluation is a continuous process which evolves throughout the life of the program. In order to maximize its benefits for both the Air Force and contractor, it should be planned, manned, and initiated early.

Risk Management/Planning: In the development of new and/or particularly innovative programs, one should manage risk by having contingency plans and fall-back positions available to preclude catastrophic failures during the development, test, and operation of the training system.

C-5 ATS

C-5 ATS Description

The C-5 ATS is a system of personnel, hardware, software, and courseware that produces qualified C-5 aircrew members and maintenance engine run personnel. The system currently consists of 24 distinct courses for the MAC formal school, in-unit upgrade, maintenance engine run qualification, and annual simulator proficiency training. It includes six weapon system trainers (WSTs), four cockpit procedures trainers (CPTs), two cargo door and cargo loading part-task trainers (PTTs), two special function trainers (SFTs), a management information system (MIS), a computer-aided instruction (CAI) system, a software support center, and a courseware support center. This integrated system will ground-train the full range of tasks for C-5 pilots (except aerial refueling hands-on part-task training), flight engineers, loadmasters, and maintenance engine run technicians. The end products are guaranteed qualified personnel. The contractor is responsible for the operation, maintenance, logistics support, and configuration management of the ATS.

C-5 ATS Issues/Lessons Learned

Air Force Issues/Lessons Learned

Simulator/Procurement: Consideration should be given to the use of a "best commercial practice" rather than the conventional military specification approach for simulator procurements. Using best commercial practice, the contractor was able to begin installation of the first of six C-5B WSTs only 20 1/2 months after contract award. Twenty-three months after contract award, the WST had undergone Phase II Federal Aviation Administration (FAA) certification and was ready for training. All six were delivered within 29 months, with major acquisition cost and time savings to the Government.

User Requirements: All users should be considered in identifying training requirements. The requirements of the primary user are usually obvious, but the unique requirements of other agencies (e.g., the Air Force Reserve, the Air National Guard, other services, and/or foreign governments) who send trainees through the program should also be considered and incorporated into the program if feasible and cost-effective.

Student Guarantee/Evaluation: A 4-hour evaluation at the end of training samples only a small percentage of the total number of training objectives. Measures obtained during the course of training should also be used in order to ensure that objectives are met. There should be a built-in evaluation process which provides timely feedback and self-correcting features throughout the life cycle of the system.

Courseware Readiness/Implementation: "Turn-key" startup of student training under a contractor-developed training system allows the contractor to make a clean break from the old methods of training to new contractor-provided methods and media. On a specified day, the previous training equipment and curricula are shut down and the contractor-provided training system is turned on. However, there can be disadvantages to that approach in that it tends to ignore the lessons learned in years of operation of the previous training system. Takeover of existing courseware and training, with a requirement to develop state-of-the-art instruction, may be an alternative. The contractor can develop new courseware and procure new training equipment while operating the existing training program. Lessons learned about student profiles, academic weakness, subject difficulty, job tasks, etc. while conducting the existing training could be incorporated into the training system during development.

Courseware Updates: One goal of any training system should be to provide training courseware concurrently with procedural, equipment, and task changes. For example, if major procedural

changes are to occur next Monday, the training system should begin training the new procedures next Monday, not 6 months from then. Courseware needs ample leadtime; therefore, training system managers need to work out with all affected agencies any advance-notice agreements that have the potential to impact training. Likewise, training managers need contractual tools to proceed quickly with changes. Major courseware changes require dollars; dollars, in turn, require approval. The best of courseware maintenance systems cannot keep training current if the user cannot cut through the red tape to approve the funding changes. In general, user organizations should commit to funding and approving training changes when they commit to making a procedural, equipment, task, or any other type of change that affects the training system. At that point, only the price should remain to be negotiated.

Courseware Configuration Control: Configuration control of courseware documentation is absolutely essential in any large training system. In the C-5 ATS, with nearly 5,000 crew performance objectives (CPOs), it is essential to cross-reference every CPO to the courseware. Likewise, crew tasks must be cross-referenced to the lessons where they are taught, and a lesson index must list all tasks taught within all lessons. With a (single) change in a basic procedure, it is possible that dozens of lessons in computer-delivered training, flight simulators, and aircraft flights may have to be revised. Without a comprehensive cross-reference data retrieval system, the affected lessons, student handouts, and visual aids cannot easily be identified. Without the cross-reference system in the C-5 ATS, contractor and customer quality control would be a nightmare.

User Acceptance: Air Force management should strive to establish user acceptance (down to the lowest level) of a training system in advance of actual implementation in order to help achieve a critical advantage. This can be done through newsletters, road shows, official correspondence, etc. Perhaps one of the most effective methods to spread the word is to publish a user's guide to the training system, complete with background operational requirements and a description of user participation in modifications to the system. Above all, one should tell it like it is and listen to the feedback.

Facilities Commonality: If more than one site is being developed, the facilities should be designed with as much standardization as possible. Thus, if a delay occurs in facility construction at one site, equipment can be diverted and installed at another without extensive site modification.

Training Task Analysis: Air Force personnel involved in training system development should approach a contractor-conducted training task analysis with an open mind. They should understand that there

are some tasks which have been trained historically--not because there was a strong rationale for doing so but merely because it had always been done that way. A thorough task listing/evaluation standards document can provide a much better definition of actual training requirements. In contrast, they should also be aware that some tasks trained in the old system were there because of lessons learned the hard way. This wisdom should be incorporated into the new system also. Thus, the Air Force user should stand up and be heard to ensure that his experience is utilized.

Computer-Based Training (CBT) System: In the interest of not overly constraining the contractor, the C-5 ATS system did not state a limiting response time to advance from one CBT screen of text/ graphics to the next. Consequently, after several months of operation, the contractor is still trying to fix the system so that it achieves a response time that is acceptable to students. Certain constraints need to be specified.

Contractor Issues/Lessons Learned

CBT: Bidders should not be required to lock-in a particular CBT system prior to contract award. That approach may make it easier for the source selection team to compare proposals, but it also forces the bidder to select a specific hardware/software configuration too far in advance of determining the particular needs of the training system. In addition, the state of the art in CBT is changing so rapidly that some future opportunities could be missed. For example, the contractor selected a particular CBT system for the C-5 and now feels that it might have been better if they could have waited until after contract award to make their final selection. The acquisition agency could provide some general functional requirements and some representative system and cost guidelines for competition that would permit the contractor to change his original selection after contract award if a more cost-effective system or approach were identified.

Task/Lesson Commonality: The common items on the master task listing should be integrated across crew positions. This list of common items might provide the opportunity to use common lessons or lesson modules for the different position courses.

Simulator/Procurement: The Government should not require the military specification approach for simulator procurement. Instead, they should permit "best commercial practice." This approach was used in the C-5 ATS, and it not only greatly cut the development time but also produced the first Phase II certified simulator in the Air Force inventory.

Student Guarantee: It is smart to require a guaranteed student product in order to provide an anchor point for product definition and acceptance testing. However, to ensure that everything is

taught to every student, the flight examiner should be given the flexibility to construct his individual checks such that anything on the master task listing may be included.

Student Performance Requirements: The Air Force must specify what the product should be (i.e., performance criteria). Despite the difficulty associated with preparing an explicit specification for many kinds of critical tasks, there is a need to work out a new approach and/or a common understanding between the Air Force and the contractor concerning how to handle certain hard-to-measure areas.

Procurement Leadtime: The timely procurement of long-leadtime items from the aircraft vendor for use in the simulator is critical for concurrent simulator development in new systems (e.g., seats, control columns, rudder pedals). There is a need for a minimum of two ship-sets. This could be a real problem for the C-17 and is an ongoing problem for all ATSs. There is a need to order parts as soon as an aircraft change is announced. Each simulator should be tied to an aircraft tail number, so that all changes that affect the aircraft result in an automatic updating of the corresponding simulator. This is the approach used by United Airlines in its training facility.

Air Force Subject Matter Experts (SMEs): The availability and continuity of aircrew SMEs is very important during the development of a new ATS. However, it was noted that the Air Force was concerned that United Airlines might take the SMEs' recommendations as official Air Force approval.

On-Site Development: Insisting on an on-site development team may affect the quality of the program because the contractor's best people may not want to go to an unattractive and/or expensive area. (Authors' note: In the opinion of the authors, on-site development is usually the preferred approach. However, in practice there have been many cases, including the C-141 and C-5, where the initial development of instructional materials was accomplished at the contractor's facilities. In these instances, the Air Force has assigned a small cadre of personnel to work in-plant with the contractor and has sent other SMEs to support specific reviews on an as-needed basis.)

Procurement Process: The procurement process should be made more responsive so that it can react more rapidly to major changes in the ATS that result from changes by the Air Force. For example, during procurement of the C-5 ATS, C-5s were introduced into Air National Guard units at Westover AFB, Maine; Stewart AFB, New York; and Kelly AFB, Texas. It was not possible to modify the basic program in time to include these new requirements as a part of the C-5 ATS development. As a consequence, Guard personnel must go to

Altus AFB, Oklahoma, for initial qualification in the C-5. This imposes a hardship on Guard personnel with other full-time jobs.

Personnel Continuity: One of the major (potential) benefits of a contractor-supported training system is the continuity of the contractor staff, for it counteracts the high personnel turnover which occurs in the military.

KC-10 ATS

KC-10 ATS Description

The KC-10 ATS is designed to provide training for KC-10 pilots, flight engineers, and boom operators. The contractor provided a total ground training package consisting of simulator acquisition and maintenance, training system design and management, and delivery of academic and simulator instruction. Training is provided at Barksdale AFB, Louisiana; March AFB, California; and Seymour Johnson AFB, North Carolina. The contractor-supported training system was delivered with the aircraft, and there never has been an Air Force counterpart for that portion of training conducted by the contractor. The contractor provides ground training for initial qualification and continuation training; the Air Force provides in-flight instruction, administers check rides, and provides mission qualification training. Initial qualification training occurs in phases. In Phase I, the contractor provides all academic instruction, followed by all simulator training. The contractor certifies that the student has met all training objectives to that point and that the student will pass an in-flight, SAC Regulation 60-4 (Standardization/Evaluation Program) check ride. (Authors' note: Air Force instructors administer a 60-4 check in the simulator prior to flight training.) Delivery of instruction involves limited CBT, but training management is accomplished almost exclusively with computers. In Phase II, Air Force instructors provide in-flight instruction and administer the 60-4 check ride. If at any time during this sequence the student fails to meet requirements, the contractor provides additional training at no additional cost to the Government. There is a penalty clause for late graduation, but it has never been exercised. (Authors' note: The Air Force and the contractor have established a system to jointly review and resolve potential student problems prior to the flight phase. As a result, there have been no flight check failures or late graduations which were attributable to the contractor's failure to perform.)

KC-10 ATS Issues/Lessons Learned

Air Force Issues/Lessons Learned

The Air Force training personnel contacted at Barksdale AFB, Louisiana, appeared to be quite pleased with the contractor's

performance and voiced no complaints about the current program. In addition, they appeared to be very satisfied with what they characterized as an atmosphere of mutual trust and cooperation between the Air Force and the contractor.

Contractor Issues/Lessons Learned

Student Performance Requirements: The Air Force should (a) define student entry skills, (b) define what they want students to do when trained, and (c) specify how much time is available for training... "but should not tell the contractor how to do it!" Then if the Air Force has a problem with the contractor's approach, the two should discuss it.

Simulator/Procurement: Simulators should be acquired using "best commercial" practice rather than the military specification approach. (Authors' note: The additional effort, cost, and time necessary to meet the administrative, data, and review requirements imposed by current military specifications and standards do not produce any real value-added to the resulting training simulators. Both the flight simulator industry and the underlying technology are relatively mature and reliable; so, there is little or no risk in a "best commercial practice" approach.)

Aircraft Data: It is often difficult for an ATS contractor to obtain information from the aircraft manufacturer; at such times, Air Force influence must be used to expedite the process. (Authors' note: The difficulty in obtaining data is a function of the ATS contractor involved. In those instances where the ATS contractor is also a major customer of the aircraft vendor, the contractor probably has at least as much influence as the Air Force itself.)

Source Selection: One opinion voiced strongly was "Go for the best contractor at source selection and not lowest bidder!"

Source Selection: There should be one contractor who is responsible for everything (i.e., training development, simulator operation, maintenance, etc.).

Some General Issues/Lessons Learned

The following lessons learned were contributed by one of the authors, Dr. Robert Nullmeyer. They are based on his collective experiences as program manager for the C-130 MATS study, as well as his involvement with a number of other proposed and ongoing programs including the C-5 ATS, C-130 ATS, B-52/KC-135 CCTS Modernization, and the SOF ATS.

Source Selection: One should not select a contractor simply on the basis of the lowest bid. One must thoroughly review the technical proposal and personnel qualifications to ascertain that the bidder has the understanding and capability to do the job.

Instructions to Offerers (ITOs): ITOs should be structured so that the level of understanding of the bidder(s) can be determined in the proposal. There should be enough information included in the ITOs to explain precisely what the user wants to see in the proposal, keeping in mind that the proposal is the primary data source for determining a prospective contractor's understanding of the requirements and capability to deliver the desired product. The RFP for the C-130 ATS tied ITOs to specific paragraphs in the SOW and requested a discussion of how specific SOW requirements would be met. It is an excellent model!

System/Subsystem Integration: It is imperative that all development programs provide adequate management, systems engineering, and technical direction to ensure the optimal integration of components into subsystems, and subsystems into a total system. This is particularly critical for activities that cut across a number of system components and/or functions (e.g., the training management system and the system test and evaluation program). There is a tendency in some programs for interrelated components and subsystems to be designed and developed in relative isolation from each other, particularly when driven by the pressures of production schedules. Therefore, there is a critical need to establish a formal organizational function with the responsibility, authority and resources to exercise technical and managerial oversight in order to ensure proper integration at all levels.

Training Design Concept: Air Force training systems must be designed to train for both peacetime and wartime operations, as inadequate performance in either case may be fatal.

Student Guarantee: Within a proficiency-based system, data should be collected throughout training to ensure that objectives are met. A single check ride covers a limited sample of behaviors and, as such, is but one piece of evidence to be considered with other available data in assessing student capabilities.

System/Program Evaluation: Experience to date suggests that many contractors appear to have an adequate understanding of the traditional student/crew evaluation concepts but not of program evaluation.

Risk Management: There obviously should be a specific plan and schedule for program development and implementation. However, the contractor should also have a contingency plan that identifies what

optional approaches will be available to minimize risk in the event that technical, schedule, etc., problems do occur.

Indefinite Quantities Contracts (IQCs): Use of an existing IQC for FEA can save time and, perhaps, dollars if the available contractor has the capability to do the job. In any event, the FEA requirements should be tailored to what the IQC contractor can reasonably accomplish with the available resources.

TTCP Survey

At the time this section was prepared, only four responses to the TTCP survey had been received. The responses included were from the UTP-2 representatives from the Australian Army and Canadian National Defence Headquarters (two inputs). These inputs are summarized below. (Authors' note: An input was also received from the U.S. Naval Training Systems Center (NTSC) representative; it included a description of the E-6A program. However, because of recent changes in this program, the authors elected to defer discussing it until additional information can be obtained and verified. Because the E-6A is a unique effort and a potentially rich source of valuable lessons learned, it will be treated in greater detail in a later report.)

Australian Army

The Australian Army representative stated that at the present time there is only one instance of contractor-supported aircrew instruction in the Australian Army. They are employing 1 civilian flight instructor from each of 2 airlines to train 6 pilots to achieve proficiency on fixed-wing Nomad light observation aircraft. Both instructors are assigned to the Army School of Aviation and report to the Senior Instructor of that wing in the same manner as the Army flying instructors on staff. These instructors were employed to release Army staff to train increasing numbers of pilots and to "establish continuity and expertise in the training of foreign personnel." He noted that, "To date the use of the contracted civilian instructors has been successful. This success has been achieved because ex-Army instructors have been employed and the contracted instructors are integrated as members of the instructional staff."

The Australian Army has recently initiated a cost-benefit study to assess the potential advantages of increasing the use of contractors to train Army pilots. The requirement for the study was prompted by a substantial increase in the number of the Army's inventory of rotary wing aircraft resulting from a large buy of Blackhawk helicopters. The U.S. Army is currently using civilian contract instructors for basic helicopter flying training at Ft. Rucker, Alabama.

Canadian Forces

The Canadian Forces (CF) have an out-service training (OST) policy which states, "All individual training shall be conducted within the DND (Department of National Defence) unless it is more appropriate and economical to obtain training outside the department." However, as is the case with the USAF, the CF are looking more and more to contract-supported training to reduce the demands on its military personnel resources to support training programs. In fact, the Primary Flying Training (PFT) Study Team was formed in early 1989 to investigate the contracting-out of CF flying training.

The CF, like the USAF, has a long history of sending personnel to factory training courses (i.e., Type 1, Contract Special Training) for initial maintenance and operator training, particularly for new systems. However, to date the CF have virtually no experience with respect to a civilian contractor-supported aircrew training system except for the C-144 Challenger program, which is described in the following paragraphs.

C-144 Aircrew Training Program. C-144 Program Description: The C-144 Challenger is a 12-passenger executive jet. Because the aircraft was purchased from a Canadian source (with ready access to the unit employing the aircraft), second- and third-line (i.e., shop and depot) maintenance have been contracted to the original equipment manufacturer (OEM). Military personnel have been restricted to first-line servicing and black box replacement. Because the Challenger's civilian and military roles are identical, CF pilots are being trained in a commercial pilot conversion course provided by Flight Safety International. The course is 2-weeks in length and includes both ground school instruction and flight simulator training. The course is complemented by an additional in-service ground school and flying training program which focuses on military procedures and standards. To maintain certification in the aircraft, CF pilots return to the contractor each year for flight simulator refresher training and aircraft operating instruction review. According to the UTP-1 representative, the benefits realized from this program include:

a. A reduction in the person-year (PY) requirement to support the fleet (for both the training and maintenance programs) of 120 PYs;

b. CF support to Canadian industry which has enabled the industry to expand into a major world-class aircraft manufacturer and support organization.

C-144 Issues/Lessons Learned: The following "lessons learned" from the Challenger OST program were identified:

a. Contractors have been willing to amend commercial course content to meet unique CF requirements.

b. Commercial training agencies, which have Canadian Ministry of Transport or FAA certification, provide training at a high standard of quality.

c. Availability of courses can be contractually guaranteed.

d. Course schedules can be made to meet CF requirements (if they are decided upon in advance and included in the contract).

e. Sole-source contractors have been responsible, in that they have not charged unreasonable rates.

f. If personnel, for whatever reason, are unavailable at the last minute to undergo training, or if the department wishes to amend course schedule or content, the department must be prepared to meet contractual obligations/penalties accordingly.

g. Ready access to commercial industry's lessons learned and experiences has improved the CF's knowledge base.

h. A close working relationship with the aircraft manufacturer has kept the CF abreast of the latest modifications and advancements to the aircraft.

i. The reluctance to accept the fact that commercial industry can train military personnel to an equally high standard is gradually being eroded.

j. Limiting maintenance personnel to solely a first-line servicing role has incurred some morale problems in that their ability to advance their experience and knowledge is correspondingly limited.

DISCUSSION

General Discussion

Perhaps the most important lesson learned from a review of major ATS programs to date is that contracting-out does not relieve the military of responsibility for that part of the program under the contractor's control. One original assumption which underlaid the promulgation of the Air Force concept of Total Contractor Training was that the Air Force (or any service) could simply define its requirements in terms of aircrew capability, student throughput, etc., and then stand back and allow the contractor to set up a training factory to produce a "guaranteed student" who could be accepted or rejected by the Air Force on the basis of a single flight check. This hardware acquisition metaphor reflected

some very serious misconceptions with respect to the nature and purpose of military aircrew training, the limits on the omniscience of contractors, and the ability of the Air Force (or anyone else) to write an unambiguous aircrew performance specification which could be satisfied by a third party without any Air Force involvement or oversight. Fortunately, most of these misconceptions are being dispelled as a result of the experience being gained with existing systems, although not without cost.

There is a growing awareness that the successful development and operation of an ATS is a team effort. It is becoming recognized that it is in the best interest of the Air Force to work with the contractor throughout the ATS life cycle to ensure that the system does not fail. The contractor can walk away from failure, but the Air Force cannot! There is also a growing awareness that contractors, unlike diamonds, are not "forever." Several of the existing ATSs have had to be recompeted before the original programs had run their full course. This clearly indicates that the Air Force cannot simply stand back and allow the contractor to do his thing without regard for how he does it in the contracted part of the system. For, no matter who develops or operates the ATS, the military customer must know enough about the system baseline to be able to transition to a new contractor if it becomes necessary, at an acceptable cost and with minimum disruption to the total training program.

Future Plans

The near-term plans for follow-on activity under this effort include expanding the core systems database by the addition of information on the C-141 and SOF ATSs. During FY91, a detailed review and analysis of the training management and evaluation components of the core systems will be conducted. The information obtained from this effort will be used to support the development of a set of guidelines for the identification of training system information and evaluation guidelines for use by acquisition agencies and using commands.

The lessons learned identified in this document, as well as those to be collected during the next phase of this effort, will also be provided in report form to the Air Force Logistics Command for inclusion in the training section of its existing lessons learned database. In addition, the same information will be submitted to the DoD Training and Performance Data Center (TPDC) for consideration as a possible nucleus entry for a new ATS lessons learned subset of its current database.

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APPENDIX A: TTCP SURVEY DOCUMENTATION

To: Members of UTP-2
From: Wayne Waag
Subject: Issues in Aircrew Contracted Instruction

1. At the last UPT-2 meeting we discussed a point paper prepared by Dr. Robert Nullmeyer of the Operations Training Division of the Air Force Human Resources Laboratory. This paper identified a number of issues resulting from the introduction of contractor- supported aircrew training in the U.S. Air Force (See Attachment 1). Prior to the conclusion of the meeting, it was agreed that contract instruction was an area of mutual concern and that a collaborative effort should be pursued. It was also agreed that I would accept responsibility for revising the original list of issues and soliciting additional inputs from other Panel Members for discussion at our next meeting.

2. Attachment 2 contains a listing of some of the major issues identified by personnel involved in ongoing or proposed contractor-supported aircrew training programs in the U.S. Air Force. This list was compiled with the support of Dr. Marty Rockway of the University of Dayton Research Institute on-site staff at AFHRL/OT. Dr. Rockway is the principal investigator on a task to develop an "Aircrew Training System Design and 'Lessons Learned' Database." A summary of this task is included as Attachment 3.

3. It is requested that you provide me with the following information for consolidation in a draft paper which will be used as the focus for further discussion at the next Panel meeting:

a. A brief description of the major contractor-supported training programs/systems implemented, under development, and/or proposed in your particular military department or branch of service. Please identify the kinds of functions/services provided by the contractor(s). It would also be helpful if the rationale for contracting out instruction/training could be identified. Use the example provided in Attachment 4 for guidance concerning the kind of information and the level of detail required at this time.

b. A listing and brief description of the major training design, development, implementation, evaluation and/or management issues associated with the actual or proposed introduction of contractor supported training.

c. A brief description of any "lessons learned" which might be applied to other ongoing or proposed contractor supported instruction/training programs.

4. Please send your inputs to....

POINT PAPER

ISSUES IN AIRCREW CONTRACTED INSTRUCTION

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There is a continuing trend within the USAF toward the use of contract resources in support of aircrew training. Contract resources have been used in a variety of applications ranging from specific courseware design to total turnkey training system design and operation. Examples include the KC-10 training program, the C-5 Aircrew Training System, and the recently awarded C-130 Aircrew Training System. To date, most applications have occurred for transport aircraft in which the training bears much in common with the airline industry. For tactical applications, contract resources have been used only in the design of training curricula and, in limited instances, for the conduct of simulation training. Given this trend toward greater use of contractor resources, there appears a need to briefly examine some of the underlying issues involving contract instruction. These include:

Contractor vs. Air Force Roles and Responsibilities. The major components of a training system are: overall training system design; courseware development and maintenance; delivery of instruction (academics, simulators, flight); maintenance of training devices, including spare parts; and training system management support including scheduling and data processing. An early decision is required regarding which of these components will be contracted and which will remain organic.

Program Goals. Why is a training support contract being contemplated? What are the anticipated benefits of contracted instruction? How will program costs be amortized? What is the government actually purchasing?

Training System Design.

1. Are there clearly superior concepts and strategies? For example, what are the strengths and weaknesses of phase of flight vs. systems-oriented training? If there are demonstrable differences, what are they, and what are the boundary conditions?

2. How do cognitive aspects (e.g., decision making, leadership, and situational awareness) enter into the design process and how should these be trained?

Attachment 1

3. What are the limitations of component technologies like CBT and simulators? Given current state-of-the-art training devices, is there a requirement for flight?

4. What training activities should be centralized in a formal school and what requirements are better met at gaining units?

5. Is an airline model appropriate for military training?

Guaranteed Student or Crewmember Performance Level. The Air Force is far from unified concerning the nature of contracted training support. On the high end, the government specifies performance requirements for training system graduates and the contractor is given freedom and responsibility to reach this objective. KC-10, C-5, and C-130 formal schools fall into this category of contracted support. A number of issues specific to student performance guarantees are emerging:

1. How should training requirements be specified? Both the traditional four-point scales and the applicable Air Force regulations appear inadequate.

2. What is the proper level of government oversight regarding contractual compliance, courseware quality assurance, and training device control?

Improved Technologies and Concepts. How can the government encourage the capital investments required to improve training systems beyond minimum requirements?

Training System Evaluation. Why should training systems be evaluated? What objectives, methodologies, and measures are required to adequately evaluate training systems at design, development, implementation and continuing operation stages of the program? Which elements need to be included in training system test and evaluation? How complete should coverage be?

If there is insufficient interest among the member nations, it is recommended that an effort be initiated to address these issues in depth with the purpose of establishing a set of guidelines for use by training organizations contemplating the use of contracted instruction. This would be accomplished through an evaluation of case studies of member nations' experiences with contracted training. Based on lessons learned from previous applications, a set of guidelines would be established identifying issues to be considered before a decision is made regarding use of contractor resources.

SOME ADDITIONAL ISSUES IN AIRCREW CONTRACTED INSTRUCTION/TRAINING

The following paragraphs identify a number of issues generated by the introduction of contractor-supported aircrew training in the U.S. Air Force. The issues listed below are intended to augment those discussed in Dr. Nullmeyer's point paper which is included as Attachment 1. These particular issues are a subset of a larger group identified during the course of gathering information for the "Aircrew Training System Design and Lessons Learned Database" described in Attachment 3. Many of the other issues identified under that project to date are felt to have relatively little generality beyond their specific Air Force context.

1. WHAT IS THE RATIONALE FOR CONTRACTING OUT AIRCREW INSTRUCTION/ TRAINING? WHAT GUIDELINES/PRINCIPLES/FACTORS ARE USED TO DETERMINE WHAT TRAINING FUNCTIONS/PHASES WILL BE PERFORMED BY A CONTRACTOR?

2. WHAT ARE THE CONSIDERATIONS, CONSTRAINTS, AND DIFFERENCES IN THE UTILIZATION OF CONTRACTOR TRAINING FOR DIFFERENT KINDS OF AIRCRAFT AND MISSIONS (E.G., BOMBERS, TRANSPORTS, FIGHTERS)?

3. WHAT ARE APPROPRIATE LEVELS OF MILITARY INVOLVEMENT/MANAGEMENT FOR VARIOUS KINDS OF CONTRACTOR-SUPPORTED TRAINING? WHAT ARE THE FACTORS THAT DETERMINE THE DEGREE OF MILITARY INVOLVEMENT AND/OR MANAGEMENT OF THE CONTRACTOR-SUPPORTED PORTIONS OF THE TRAINING PROGRAM? HOW DOES THE MILITARY AND CONTRACTOR MANAGEMENT STRUCTURE CHANGE AT VARIOUS STAGES IN THE TRAINING SYSTEM LIFE CYCLE?

4. WHAT MECHANISMS SHOULD BE SET UP FOR RESOLVING DIFFERENCES OF OPINION BETWEEN THE MILITARY AND CONTRACTOR? (FOR EXISTING SYSTEMS, "WHAT MECHANISMS HAVE BEEN SET UP AND HOW SUCCESSFUL HAVE THEY BEEN?")

5. WHAT (IF ANY) KIND OF STUDENT PERFORMANCE GUARANTEE SHOULD BE WRITTEN INTO THE CONTRACT? HOW DOES THE MILITARY INSURE THAT THE GUARANTEE HAS BEEN MET? SHOULD A PENALTY (INCENTIVE) CLAUSE FOR NON-COMPLIANCE BE INCLUDED? (HAS SUCH A CLAUSE EVER BEEN EXERCISED IN AN EXISTING CONTRACTOR-SUPPORTED SYSTEM?)

6. DOES A STUDENT GUARANTEE CONSTRAIN THE DESIGN OF THE TRAINING SYSTEM? FOR EXAMPLE, WHAT PROBLEMS/INEFFICIENCIES MAY BE INTRODUCED BY PHASE OF FLIGHT, FUNCTIONAL CONTEXT, OR OTHER MIXED APPROACH WHERE TRAINING RESPONSIBILITY MAY SHIFT BACK AND FORTH BETWEEN THE MILITARY AND CONTRACTOR? (A COROLLARY ISSUE IS "HOW DOES THE FRONT-END LOADING OF CONTRACTOR TRAINING RESTRICT THE DESIGN OF THE TOTAL TRAINING SYSTEM?")

7. WHAT TESTS/MEASURES ARE USED TO INSURE THAT ALL CONTRACTOR-SUPPORTED TRAINING OBJECTIVES HAVE BEEN MET (E.G., PAPER AND PENCIL TESTS, PART-TASK TRAINERS, SIMULATORS, AIRCRAFT, ETC.)? HOW DOES

MILITARY TRACK THE CONTRACT PORTION OF TRAINING TO VERIFY THAT ALL OBJECTIVES HAVE BEEN SATISFIED?

8. WHAT ARE THE REQUIREMENTS FOR A TRAINING MANAGEMENT INFORMATION DATA BASE? WHAT KINDS OF DATA SHOULD BE INCLUDED AND SHOULD THERE BE ONE INTEGRATED DATA BASE OR SEVERAL? ARE REQUIREMENTS DIFFERENT AS A FUNCTION OF THE LEVEL OF CONTRACTOR INVOLVEMENT? WHAT PROBLEMS ARE INTRODUCED BY CLASSIFIED TRAINING INFORMATION TO WHICH THE CONTRACTOR DOES NOT HAVE ACCESS?

9. WHAT ARE THE GUIDELINES FOR THE TEST AND EVALUATION OF CONTRACTOR-SUPPORTED TRAINING? IN THOSE INSTANCES WHERE AN EXISTING MILITARY TRAINING SYSTEM (OR FUNCTION) IS REDESIGNED AND/OR TRANSITIONED TO A CONTRACTOR, HOW IS THE COST-EFFECTIVENESS (OR PAYOFF) DETERMINED? WHAT ARE THE ADVANTAGES/DISADVANTAGES OF MILITARY, CONTRACTOR, AND/OR THIRD PARTY EVALUATORS?

10. WHAT MECHANISMS CAN BE BUILT INTO A SHARED MILITARY/CONTRACTOR-SUPPORTED TRAINING SYSTEM TO INSURE THAT IT HAS THE CAPABILITY TO INTEGRATE CHANGES IN TACTICS, DOCTRINE, NEW TECHNOLOGY, ETC. EFFECTIVELY AND EFFICIENTLY? FOR EXAMPLE, HOW ARE NEW OR DIFFERENT OPERATIONAL REQUIREMENTS DETERMINED? HOW DO YOU HEDGE UNCERTAINTIES/RISK?

11. WHAT ARE SOME OF THE MAJOR LESSONS LEARNED IN THE DESIGN, DEVELOPMENT, EVALUATION, AND OPERATION AND MAINTENANCE OF CONTRACTED INSTRUCTION/TRAINING WHICH MAY BE APPLIED TO NEW OR DIFFERENT AIRCREW TRAINING PROGRAMS?

TITLE: Aircrew Training System (ATS) Design and "Lessons Learned" Database

R&D NEED: Air Force experience with respect to the design, development, implementation, evaluation and operation of contractor-supported aircrew training systems is extremely limited. To date most of the Air Force's major ATS programs are in the early stages of procurement or development. As a result, there is a very limited amount of empirical and/or experiential information to provide guidance during the acquisition, development, implementation, evaluation, and operation of new or proposed systems. In fact, in virtually all of the systems reviewed to date, most of the program managers began at ground zero and had to "learn by doing." In the case of the B-52/KC-135 Modernization Program, the SAC program manager is benefiting from the previous pre-contractual experiences of AFHRL and MAC with the C-130 ATS and the C-130 Model Aircrew Training System study. However, even in these instances, the experiences shared cover only the very early phases of system conceptualization, analysis, specification, and development. In any case, to be solely dependent on occasional personal contacts or undocumented institutional memory for guidance is an unacceptably inefficient procedure for the development of major training programs. Thus, there is a critical need to collect, store, document, and disseminate experientially based lessons learned to training system acquisition offices and operational training organizations to insure a cost-effective approach in the design, development, and utilization of total aircrew training systems. Because of the number of aircrew training systems at various stages of development at the present time, a window of opportunity is available for initiating a study of lessons learned during various phases of the training system life cycle.

PLANNED R&D: The objective of this effort is to collect, store, and document relevant lessons learned by Air Force and contractor personnel throughout the total training system life cycle. Particular emphasis will be devoted to lessons learned in any aspect of system design, development, implementation, and operation which can provide useful guidance to other existing or proposed systems.

The approach for this effort consists of three overlapping phases.

Phase 1. The first phase includes a series of visits to sites where total training systems are being planned, developed, and/or operated. Major training system issues and lessons learned are being solicited from both contractor and military personnel involved in all phases of system design, development, implementation, operation, and maintenance. Much of the initial information is being developed using face-to-face personal interviews. During these initial contacts, specific problem areas

and issues are being identified during somewhat open-ended discussions. Where feasible, an effort is made to obtain additional information concerning what problems were experienced and what actions were taken to resolve them; what non-routine decisions were made that had unexpectedly good (or bad) outcomes; and what approaches, techniques, and procedures were developed that might be of value to others. After a stable set of potentially profitable areas and issues have been identified, they will be monitored through periodic visits, telephone communications, and structured questionnaires. In addition, for selected high priority areas, key program personnel will be requested to document important activities, decisions, and lessons learned in special logs or journals.

Phase 2. During the second phase, a computerized database will be developed and maintained for the storage and retrieval of lessons learned, as well other relevant training system design information. This database will be the initial repository for the information gathered as a part of Phase 1 of this task, as well as the data obtained from the other tasks in this program. In its initial configuration, the database structure will be designed using a relatively limited number of fields reflecting such things as the type of system, the particular stage of the training system life cycle, the level of contractor involvement, the instructional system functions and training resources involved, and R&D needs. As more information becomes available, the database structure will be refined to increase its utility for both training system design and R&D applications. The initial database is being implemented on a standard Air Force Z-248 computer using DBase III Plus for database management. This should provide a high degree of access and transportability of database information to other agencies and/or locations.

Phase 3. During Phase 3, the information concerning major issues and lessons learned will be documented in a series of user-oriented reports and guidelines for dissemination to procurement personnel, training system designers, training system acquisition agencies, training managers, and R&D personnel. The guidelines should effect a significant improvement in the effectiveness and efficiency of the system design, development and utilization processes. In addition, the computerized database should be a prime source of guidance for identifying, organizing, and prioritizing significant training system R&D issues.

SAMPLE DESCRIPTION OF CONTRACTOR-SUPPORTED TRAINING SYSTEM

The following is a brief description of the contractor-supported aircrew training program for the U.S. Air Force's E-3A system. It is provided to serve as an example of the level of detail desired at this time for the descriptions of contracted instruction/training submitted with your issues and lessons learned inputs.

TITLE: CONTRACT-SUPPORTED TRAINING FOR THE E-3A WEAPON SYSTEM.

The Tactical Air Command of the U.S. Air Force awarded a contract to the Boeing Military Aircraft Company in April 1984 to provide E-3A aircrew initial qualification training. The contractor designed the training program, purchased a computer-based training system, developed courseware, and acquired two 707 aircraft for use as surrogate E-3A trainers. Contract personnel conduct all ground training (academics, simulator, part-task trainers, etc.) for the initial qualification of E-3A pilots, navigators, and flight engineers. The Air Force conducts all formal simulator and in-flight evaluations as well as all in-flight training of pilots and copilots in the surrogate aircraft. During these training flights contractor personnel serve as flight engineers. The contractor is also responsible for the operation and maintenance of all instructional resources including the 707 aircraft, flight simulators, and the computer-based training system. The benefits realized from this program include: (a) reduction in the use of very expensive E-3A airframes for proficiency training (this has led to an increase in the number of operational missions supported by the available E-3A fleet); (b) a more stable contractor instructor force; and, (c) a significant reduction in the costs associated with initial qualification training. (Estimated cost prior to contract--$22M/year. Estimated current costs--$10-12M/year.)

APPENDIX B: ADDITIONAL "LESSONS LEARNED" DATA

E-3A TRAINING SYSTEM

SYSTEM DESCRIPTION

The Tactical Air Command of the U.S. Air Force awarded a contract to the Boeing Military Aircraft Company in April 1984 to provide E-3A aircrew initial qualification training. The contractor designed the training program, purchased a computer-based training system, developed courseware, and acquired two 707 aircraft for use as surrogate E-3A trainers. Contract personnel conduct all ground training (academics, simulator, part-task trainers, etc.) for the initial qualification of E-3A pilots, navigators, and flight engineers. The Air Force conducts all formal simulator and in-flight evaluations, as well as all in-flight training of pilots and copilots in the surrogate aircraft. During these training flights, contractor personnel serve as flight engineers. The contractor is also responsible for the operation and maintenance of all instructional resources including the 707 aircraft, flight simulators, and the computer-based training system. The benefits realized from this program include: (a) a reduction in the use of very expensive E-3A airframes for proficiency training (this has led to an increase in the number of operational missions supported by the available E-3A fleet); (b) a more stable contractor instructor force; and (c) a significant reduction in the costs associated with initial qualification training. (Estimated cost prior to contract: $22M/year. Estimated current costs: $10-12M/year.)

E-3A ISSUES/LESSONS LEARNED

1. PROGRAM ADVOCACY: Involve senior Air Force leadership early and get their names on the dotted line.

2. TRAINING EMPHASIS: Address each crew position with sufficient emphasis. Navigator training appears to be underemphasized in E-3 program.

3. MANAGEMENT: Retain management reserve funds in contract to handle contingencies.

4. MANAGEMENT: Provide a USAF liaison at each of the operational units.

5. INFORMATION: Engage in crosstalk with other programs to profit from experiences of other systems.